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The implementation of analytics in support of student success requires effective use of feedback and interventions, as well as a system by which the use of feedback and institutional supports can be tracked and evaluated.

Learner Analytics and Student Success Interventions

Matthew D. Pistilli

Imagine this scenario: You are a new faculty member and have been assigned to teach three sections of an introductory psychology class. When you receive your course rosters, you realize that over 200 students will be in each section, that you know nothing about these students, and that the department chair has charged you with increasing success rates in the course. As the first assignments and assessments of the semester come around, you notice that you have a wide range of performance, including a large proportion of students earning a C or less. Given that you teach over 600 students and have other requirements as a faculty member, you wonder how you might be able to provide meaningful feedback to students in a data-driven and efficient manner.

Enter learner analytics. Learner analytics is a more focused

realm of the more widely known learning analytics. Defined by the Society of Learning Analytics Research (SoLAR, 2012), learning analytics focuses on “the measurement, collection, analysis and reporting of data about learners and their contexts, for purposes of understanding and optimizing learning and the environments in which it occurs.” This is a prime example of institutions turning to business intelligence techniques that utilize prescriptive interventions to augment and support student success.

While learning can be optimized at the course or section level, learner analytics looks for the variables contributing to risks faced by individual learners, and helps to identify targeted interventions that mitigate the risks individual learners experience while participating in their academic work. The end state of learner analytics is to identify risk and determine which interventions are likely to get the right prescriptive information to the right learners at the right time in the right way so that their performance improves.

The Right Information to the Right Students

The first component of intervening with students is to determine what information needs to be presented to students. Here, we must begin with intent. What message needs to be

conveyed to students? Do they need to know the grade they have earned on an assignment? Do they need to know they're not performing at a level that will ensure success in the course? Does the instructor simply want to communicate the fact that resources exist to help students be successful, regardless of current performance? Ultimately, in order to present the right information—indeed, a relative term depending on perspective—one must first determine what needs to be provided. That will shape both the message crafted and the delivery mechanism employed.

The Roles of Feedback in Advising and Academic Achievement

Feedback is an exchange between two or more persons—which can be done in person or mediated by a computer or phone—so that individuals are better informed about the extent to which their work was done correctly or incorrectly, or where they are with relation to specific course outcomes (Tanes, Arnold, Selzer King, & Remnet, 2011). Chickering and Gamson (1987) note that frequent feedback is best—“students need chances to reflect on what they have learned, what they still need to know, and how to assess themselves” (p. 5). Tunstall and Gipps (1996) take this further, indicating that the use of feedback can bring to light what

students have learned and what they are able to do as a result.

Ultimately, Hattie and Timperley (2007) describe feedback as “one of the most powerful influences on learning and achievement” (p. 81).

Feedback brings with it many positive outcomes. In higher education environments, greater levels of interaction between students and faculty can lead to cognitive and personal development for students (Astin, 1993). Feedback students perceive as being fair or encouraging is seen as more effective (Lizzio & Wilson, 2008) and is even more effective when the person providing the feedback is viewed as being highly credible (Poulos & Mahony, 2008). When feedback is issued to students from credible sources, is fair or encouraging, and is provided in a timely manner, students are more likely to learn from experiences in ways that should make them more successful in the future. By inserting learning theory into the implementation of analytics, institutions can ensure a strong implementation and the greatest chance of realizing successful outcomes.

Social Cognitive Theory

Learning from experiences is at the core of Bandura's (1977) social cognitive theory (SCT), and feedback is a key way to inform students about actions that can be taken to improve a course outcome. SCT tells us that learning occurs in situations where people can engage with tasks or problems as well as through observing those around them work on similar endeavors. Students are motivated by a specific outcome perceived to be desirable—or at least more desirable than their current situation, something instructors can provide through a learning analytics-driven intervention. Bandura (2001) also notes that by reviewing expectations, people aim to achieve outcomes that are positive in nature. Put differently, students examine the potential consequences associated with various courses of action and plan their next steps accordingly. This agentic approach, where students are able to “exercise some control over” (Bandura, 1991, p. 249) the ways in which they plan to deal with a situation, solve a problem, feel about something, or become motivated to act at all, is the basis for a person's self-efficacy (Bandura, 1986).

Self-efficacy is rooted in a person's self-appraisal of the beliefs they hold about their abilities to perform various actions or

tasks (Bandura, 1977, 1986). Applying self-efficacy to the educational environment, Schunk (1990) describes students' perception of their ability to apply the necessary behaviors or knowledge within a classroom. Studies, such as those conducted by Zajacova, Lynch, and Espenshade (2005) and Gore (2006), demonstrate that academic self-efficacy both strongly predicts first-year college student success and grows over the course of a semester as students experience success. Student success influenced by feedback sets a "psychological stage for a successful college experience" (Betz, 2007, p. 409).

Part of that stage setting involves timing information presented to students so that it can be as effective as possible. It is also important to consider the messages and the media employed to garner the greatest effect. Torrance (2012) illustrates this need, noting that feedback cannot be something that is just given to students, but is actually something that can be "acted upon" (p. 330). Torrance also points that there is an emotional toll associated with receiving feedback that affects how students feel about themselves and their abilities. It is important that the information provided to students be formative in nature—both in the intent

behind the feedback (to help students improve) and in the effect portrayed (so that students do not feel defeated). While feedback to students is not always positive, it can be provided in ways that promote learning and growth. However, simply providing feedback is insufficient; we must also look to inform the learning process for both students and instructors.

The Right Time in the Right Way

Not all feedback is created equally, and the delivery of feedback in and of itself is rarely sufficient with regard to helping a student succeed. Learning analytics provides an opportunity to better inform both learners and teachers and the ways in which feedback can be derived from a learning analytics solution and presented to students varies greatly.

Analytics-driven feedback must connect information provided to students to context in both relevant and timely manners. Feedback, applied appropriately, can also help to influence effective learning dispositions (Gray, McGuinness, Owende, & Hofmann, 2016), including deep learning approaches, students being able to self-regulate themselves around getting coursework done, setting learning goals, and increasing intellectual curiosity.

Khan and Pardo (2016) examined feedback effectiveness via the ways in which students employed dashboards showing course performance over time. They found no correlation between the use of the dashboard, which reflected course performance, and students' grades; however, they did find that students did, in fact, want to have feedback presented to them. In the narrative of not all feedback being created equal, this is an example of how simply telling students how they were doing was ineffective; more qualitative feedback was determined to be necessary in order to help students improve their performance over time.

In Chapter 6 of this volume, Fritz describes the effect of providing feedback to students on the number of times they were logging into the learning management system (LMS) as compared to their peers, what their grade was, and what were the general grades of those who had more or less interaction with the LMS than themselves. While the Check My Activity feedback is still dashboard based, the ability of students to drill into the information presented to them, and subsequently use that information to change their study habits and behaviors, resulted in students using the system to be nearly twice as likely to get at least a

C in a course when compared to those who had access to Check My Activity but never used it.

The desire for feedback should not be surprising. Most students go to college to learn, and they expect to be guided in that endeavor. The challenge, then, is not knowing *if* students want feedback, but, rather, in *how* to provide it to them in ways that will be effective. Gettings, Waters, Selzer King, Tanes, and Pistilli (2013) and Ehle and Gettings (2013) conducted studies at Purdue University to get directly at this.

At Purdue, faculty had access to a system called *Course Signals*, a technology developed by Instructional Technology at Purdue and later licensed to Ellucian. Course Signals is a learning analytics technology

developed on a predictive analytic model that contains elements from the academic technologies and the student information system. The model is behaviorally based and considers student performance, effort, and characteristics. The algorithm runs on real-time data and provides a risk indicator for each student. Using this risk indicator (a red, yellow, or green traffic signal) as a formative guide, faculty members can give students in their courses meaningful feedback, suggesting behaviors that students might wish to change to improve their chances of success, thus placing the emphasis squarely on action. (Pistilli, Arnold, & Bethune, 2012, para 5)
Gettings et al.'s (2013) study focused on what students

wanted to get for feedback via e-mail from instructors using Course Signals in their classes. Students in the study first provided reactions to messages they might receive from an instructor about their course performance. Afterwards, they were asked to rewrite the messages presented to them in ways that would be more palatable to them, composing messages for students performing poorly in a course, students doing moderately well, and students showing no signs of struggle. Student-written messages were examined for positive and negative effect, self-efficacy promotion, perceived motivational effects, and the extent to which a message facilitated interaction with the instructor.

Several key findings emerged from the examination of students' responses to the instruments and the messages they wrote that all correspond to general theories of feedback. First, and as discussed by Chickering and Gamson (1987), Hartley and Chesworth (2000), Thompson and Mazer (2009), and Yorke and Longden (2006), among others, the concept of "early and often" feedback is paramount. Prompt feedback is important— providing feedback about performance on homework after a test on the same concept has been taken is wholly ineffective. Feedback must be

presented in a timely enough manner so that students can take it into account as they move forward.

Furthermore, providing the same feedback in multiple formats, such as e-mail, broad course discussions, and one-on-one conversations, was also seen as highly beneficial for the students. Gettings et al. (2013) also found that including dates or references to recent campus or class events (for example, a test, homecoming, or spring break) lent both relevancy and credibility to messages. Wise's (2014) research also indicates that the timeliness and relevance of feedback is essential in order for appropriate meaning to be made by the learner.

Students indicated that they wanted *explicit* feedback; that is, they wanted direct actions they could take to maintain or improve their grades or performance, which concurs with Tanes et al.'s (2011) finding that feedback emphasizing outcomes, rather than past behaviors, would be the most successful. Gettings et al. (2013) also noted that students desired feedback that focused on the outcomes of specific behaviors. Telling students to simply spend more time studying was found to be ineffective, while indicating that students who spend a certain amount of time studying a

specific topic in a given manner (such as flash cards for anatomy or group studying for biology labs) tended to do better overall and feedback was received much more openly and readily by students.

Ultimately, however, not all students respond the same way to similar kinds of feedback. Smith, Lange, and Huston (2012) found that among online community college students, those receiving direct contact via phone or voicemail fared much better than those to whom outreach efforts were unsuccessful (wrong or disconnected numbers, no answer). Separately, e-mails automatically sent to students at the beginning of a term suggesting that students log in to their courses on the first day of the course resulted in a 40% decrease in students dropping the course later in the term for some groups of students, but not for all classes tested.

The construction of messages, along with their tone, also play a role in their effectiveness. Messages perceived to be encouraging of progress, regardless of actual performance, yielded increased levels of self-efficacy, which in turn facilitated student success.

Messages threatening students were wholly ineffective.

Furthermore, messages that were interpreted as constructive in

nature and encouraging in tone were determined to be the most effective of all. These results are bolstered by research conducted by Bjorklund, Parente, and Sathianathan (2004) and Lizzio and Wilson (2008), who found that constructive and encouraging feedback is more effective and increases students' gains in problem solving and communication skills.

A separate study conducted by Wise, Zhao, and Hausknecht (2013) noted that analysis of interventions resulted not only in online students recognizing utility in the information presented to them but also that students quickly noticed that information was not included in the algorithm that prompted the intervention to be initiated. Aguilar, Lonn, and Teasley (2014) note that interviews with students can help to mitigate this disconnect, as well as shape appropriate interventions and messaging to students. Additionally, Aguilar et al. (2014) indicated the importance of also seeking feedback from those actually doing the intervening, be that faculty, staff, or peers, regardless of method.

Ultimately, simply providing feedback for the sake of feedback is unnecessary; there must be intentionality behind the feedback, and those intentions need to consider how the

information will be received and what students can do with it.

Too Much of a Good Thing?

Feedback, while important to student performance, personal development, and academic self-efficacy, can also create challenges for students. Tanes et al. (2011) noted that lengthy feedback is generally unsuccessful. While students in danger of doing poorly in a class need more information on how to improve their performance, there is a risk of giving too much detail to students such that they won't read the messages at all. As Tanes et al. (2011) state, "instructors should succinctly focus on ways to improve student out- comes" in their feedback to students (p. 2420).

Beyond the message length itself, there is also the possibility that too much feedback in general can have deleterious effects. Wise (2014) cautions that the overuse of feedback derived from analytics, what she terms "omnipresent analytics," presents two specific dangers. First, the notion of receiving feedback at any time or in any place can result in the feedback never being reviewed. Basically, too much information received too often is ineffective. Second, Wise indicates that the constant attention to numbers or

metrics can find students playing to the numbers in an effort to get the best possible score but not engaging with the material in an effort to learn it.

In short, there is an optimal window of how much information to provide to students, how often to provide it, and the tone to strike in the feedback itself. To determine what the appropriate window, manner, and tone is, one must talk to both the provider and the receiver of feedback.

Closing the Loop: Considerations for Implementation

The prospect of providing feedback to students is only effective if the extent to which that feedback was helpful is determined. Barring some form of assessment, it is impossible to know if any messaging or interventions provided were actually effective. Clow (2012) notes that it also is important to examine intermediate efforts, like interventions, and not just look to assess the outcome of our actions.

As such, developing interventions and administering them as part of an analytics endeavor requires careful thought and planning. This thought should include input from many different levels of stakeholders. Drachsler and Greller (2012) discuss stakeholders in

the realm of those who are “the contributors and beneficiaries of learning analytics ... [including] *data clients* as well as *data subjects*” (p. 120, emphasis in original). Data clients usually are those who benefit from the data and who will be doing the acting upon the results of the analytic algorithm. One might conceptualize the data clients as teachers or administrators of various academic resources. Data subjects, on the other hand, are usually those whose data is supplied to the algorithm or process, or, most often, the students being affected by this implementation.

So often analytics are viewed as a way of identifying students at risk of something, be that failing a course, leaving an institution, or engaging in some other behavior. To the contrary, analytics must drive faculty–student interaction, which Draschler and Greller (2012) note is one of the greatest potential benefits of implementing learning analytics. Nelson Laird, Chen, and Kuh’s (2008) and Chickering and Gamson’s (1987) research underscores this, demonstrating that institutions that have higher-than-normal levels of student success have increased levels of faculty–student interaction. However, the outcomes of any learner analytics effort must be measured. Analysis of the kinds of interventions provided,

language or methodologies employed, and their overall effectiveness must be fully assessed— and done so in ways that identify diagnostic, predictive, and prescriptive methods that support educational transformation efforts (Casonato, Lapkin, Beyer, Genovese, & Friedman, 2011).

Transforming higher education may seem like an impossible daunting task. However, learner analytics can take this seemingly impossible task and make it much more manageable through creating a means to provide meaningful, targeted feedback to identified students in efficient and effective manners. Through providing feedback to students, and examining the rhetoric employed and effect portrayed therein, we create a highly powerful means of helping students not only improve their performance but also become better overall students.

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